Designing a Knowledge Awareness Navigation for Ubiquitous Learning Environment

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Abstract-*Ubiquitous learning is characterized by providing intuitive ways for identifying right learning objects, right learning contents and right learning aids in the right place at the right time. Our context aware ubiquitous learning platform applies the GPS and image recognition technology for designing a context-aware function. To help learner locates the right place and the learning objects for ubiquitous learning effectively, this paper introduces a Knowledge Awareness Navigation to support the learners while learning natural herbs in the real worlds. This platform applies GPS and image recognition technology to implement the knowledge awareness navigation for U-learning. It uses the GPS ubiquitous technology to detect the right place for learning which is personalized according to the learner's current need and location, then with the help of the blade image recognition, the learner is able to search relative knowledge of the natural herbs.*

Keywords: Ubiquitous Learning, GPS, Context-Aware, Image Recognition.

1. Introduction

With the flourishing development of the wireless network and context awareness technology, the convenience of the digital learning has been improved. Though, the issue of how to adapt context awareness technology to the U-Learning environment of life-long learners has been popularly investigated in recent years. Especially, ubiquitous learning is characterized by providing intuitive ways for identifying right collaborators, right contents and right services in the right place at the right time based on learners surrounding context such as where and when the learners are, what the right places, learning resources and services available for the learners, and who are the learning collaborators that match the learners' need [16][19][13].

As a result, the effectiveness and efficiency of ubiquitous learning heavily relies on the surrounding context of learners. Therefore, this paper introduction a context aware ubiquitous learning platform applies the GPS and image recognition technology for designing a context-aware function. To help learner locates the right place and the learning objects for ubiquitous learning effectively. Fundamentally, we develop a Knowledge Awareness Navigation To support the learners while learning natural herbs in the real worlds. The learner can locates the position of a natural herb in a real environment context through the guiding of the GPA with the use of a PDA or smart pone. Then, if the learner needs to search for the learning knowledge of the natural herbs, he or she can use the built-in camera of the PDA or smart pone to take the picture of the blade, the image is then transmitted into the PDA or smart pone to start the search the learning resource database without the needs of knowing the name of the plants. After the image outline of the blade is scanned by the image recognition system, the obtained information can then help the learner in the search of the relevant knowledge. In addition, due to progress of device and communication technology, we can now implement knowledge awareness navigation aids for ubiquitous learning well. This knowledge awareness navigation particularly suitable for building an ubiquitous learning environments for life-long learning and also allows the learner to be free of the time and space for learning.

2. Ubiquitous Learning

M-Learning is a learning form that allows learning anywhere, anytime with the use of Digital Mobile Devices. Learning is therefore not restricted to any particular places [11]. U-Learning and M-Learning are very similar, but after the brought-up of the ubiquitous learning [14], the development of the information technology and the construction of the wireless network, devices and network equipped with computing capability are able to be found anywhere within our living environment. The environment of the Mobile

Learning is constantly improving, and as a consequence we are able to learning anywhere, anytime with the use of Digital Mobile Devices [19]. This is the Ubiquitous Learning. In the structure of the Ubiquitous Learning, even if the user is in the open, he or she may still get connected to the network through wireless network and a PDA or smart phone. We are able to obtain and learn new knowledge through the net anywhere, anytime [12]. Learning is no more restricted by the time or space. Meanwhile, the main characteristics of context-aware and Computer Supported Ubiquitous Learning (CSUL) environment are shown as following eight aspects: mobility, location awareness, seamlessness, situation awareness, social awareness, adaptability, pervasiveness, and interoperability [17][1]:

Mobility: The continuousness of computing while learners move from one position to another place.

Location awareness: The identification of learners' locations.

Seamlessness: The supplying of everlasting service sessions under any connection with any device.

Situation awareness: The detection of learners' various situated scenarios, and the knowledge of what learners are doing with whom at what time and where. This helps learners to notice the features of the problem situations that make particular actions relevant.

Social awareness: The awareness of learners' social relationship. The awareness of learners' social relationship, including what do they know? What are they doing at a moment? What are their knowledge competence and social familiarity?

Adaptability: The adaptability of learning resources and services depending on learners' accessibility, preferences, and need at a moment.

Pervasiveness: The supporting of intuitive and transparent way of accessing learning resources and services, predicting what learners need before their explicit expressions.

Interoperability: The interoperable application between different standards of learning resources, services, and platforms

3. System Architecture and Implementation

The ubiquitous environment built by this research allows the learner to be free of the constrains of the time and space. A PDA or smart phone connect to the herb plants learning resource database, and with the use of GPS and blade image recognition function can help learners in the process of learning. The U-Learning system architecture is shown as Figure 3.1. And, the application context of the platform is shown as Figure 3.2.

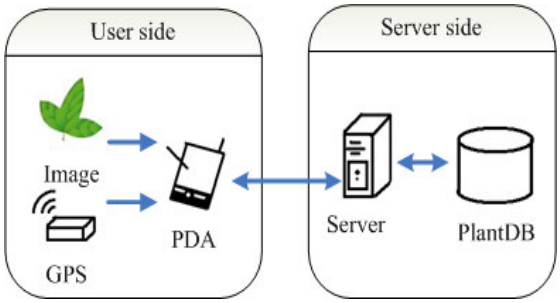

Figure 3.1 the structure of this platform

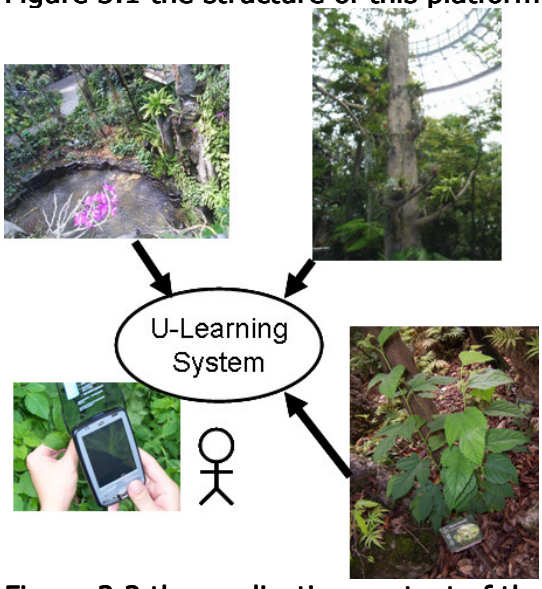

Figure 3.2 the application context of the platform

The main characteristics of the Knowledge awareness navigation for the U-learning environment constructed by this system include:

Portability: The portable digital device PDA or smart phone which allows the learner to carry with ease and so the learner can proceeds with learning in the digital fashion.

Seamlessness: The learner can connects the host anywhere, anytime with wireless communication technology. Useful data can then be obtained seamlessly in real-time.

Location awareness: Through GPS, the global satellite positioning, the position of the learner can be identified and showed on the digital map. It can guide learner to locate a botanical garden that suitable for observations and learning of natural herbs. This function enables the learner to learn rapidly the position of the subject and proceed with the learning of the real context.

Situation awareness: Learner can apply the GPS ubiquitoustechnology to detect the right place for learning which is personalized according to the learner's current need and location. This helps learners to find out a real environment and real learning location that learner can find the real learning objects, for example natural herbs.

Pervasiveness: A learner can use the built-in camera of the PDA or smart pone to take the picture of the blade, the image is then transmitted into the PDA or smart pone to retrieve the learning resource database without the needs of knowing the name of the plants. After the image outline of the blade is scanned by the image recognition system, the obtained information can then help the learner in the search of the relevant knowledge.

The main components of Knowledge Awareness Navigation of ubiquitous learning system (the main screen of system interface as Figure 3.3) showing as following:

Figure 3.3 the main screen of the system

3.1. GPS Guiding Positioning Function

Through the GPS receiver, the learner can instantly obtain his/her information of the longitude and latitude. This system acquires the real-time position information with the use of GPS. The real-time information is then worked in coordination with the satellite image of the botanical garden and the coordinates of the plant in the botanical garden to effectuate the Guiding Positioning Function of the learning of the subject.

The Guiding Positioning Function of this research has picked a botanical garden in the middle part of Taiwan as the theme. Google map combine with wireless network transmit the location of the learning to the host which then match the location with the coordinates of the plant in the data base. A plant nearby the learner is searched and the location of that herb plant is displayed to the learner with a visualized map. This helps the learner to find quickly the position of the plant intended for learning. For instance, if the learner intends to search for the position of Taiwan acacia within the garden, the learner can use the GPS Guiding Positioning System to acquire the relevant location information and get to that location promptly. As shown in Figure 3.4

Figure 3.4 The interface of GPS Guiding Positioning Function t

3.2. The herb's blade Image Recognition of Function

It has turned out to be more and more popular for a Digital Portable Device to be equipped with a camera. And when working with the high-speed wireless network transmission, the image can be quickly uploaded to the host. This system processed the image of the herb's blade with Image Recognition algorithm and the outline characteristics of that particular blade are then identified. The characteristic values in the plant data base are then used to match with the identified characteristic values, the relevant knowledge of a plant with high similarity to the intended sample is identified to help in the learning process. For the sake of increasing the convenience of acquiring

information, the built-in digital camera of the Digital Portable Device can take the image of the plant's blade and obtain the information of that particular plant with the algorithm of Image Recognition

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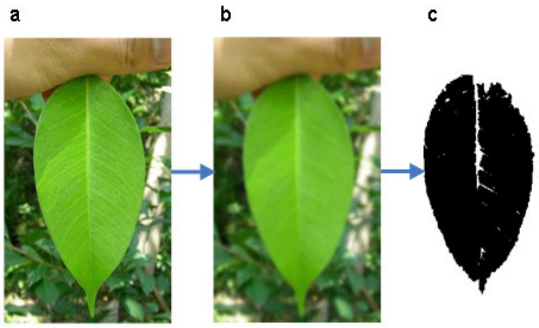

Figure 3.5 the process of the Image processing, a: the image taken by the camera function, b: the image after the noise filtration, c: the outline Image of the plant

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Figure 3.6 the operation screen of the image recognition

4. The process of herb's blade Image Recognition

The plant Image Recognition algorithm of this research uses the outline of the blade as its main categorization item and it has the following four stages:

(1): The elimination of the image noise. With the use of Gaussian Smoothing Algorithm (1)(R. Fergus et al, 2006), the noise is filtered and the identification of the image is increased. x and y are the radius of the blur. As shown in Figure 3.4b: Gaussian blur：

$$G(x, y) = \frac{1}{2\pi\sigma^2} e^{-(x^2 + y^2)/(2\sigma^2)} \qquad (1)$$

(2): Identify the blade of the plant. Through the analysis of the colors on the plant's blade, the critical plant blade images are separated. As shown in Figure 3.5c

(3): The outline of the blade is matched with the data base of the plant, the similar plant is identified. Within the data base of the plant, the same plant can have numerous images and a floating point between the value of 0 and 1 is obtained after the matching. The higher the value is, the higher the similarity.

(4): The matching result of the plant transmitted relevant learning materials back to the user according to the order of the similarity.

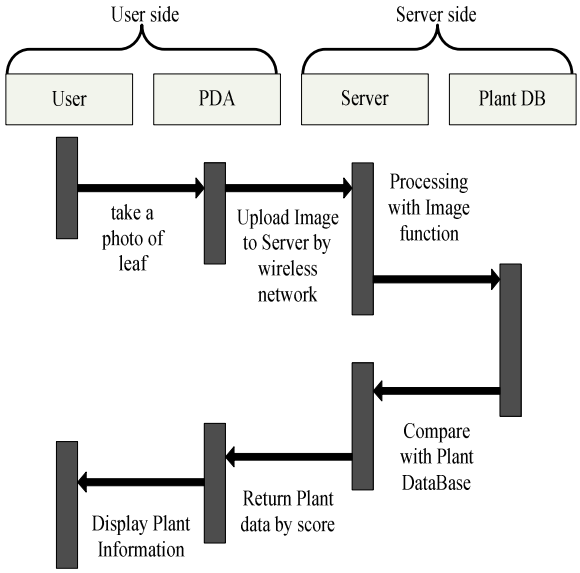

Figure 3.7 the sequence diagram of the herb blade Image recognition

Figure 3.8 the operation screen of the Image Recognition

5. Conclusion

The Knowledge Awareness Navigation of ubiquitous learning environment built by this research has integrated wireless network technology, GPS and Image Recognition to help the learner to learn about the knowledge of natural herbs anywhere, anytime. Through the assistance of the GPS, the leaner can identifies the location of the intended natural herb of study in the real world environment. This also helps the learner in the guiding and positioning in the real learning context so that the learner can acquire the learning resources in the real environment with more easily and more effectively. On the other hand, with the plant blade outline Image Recognition function provided by this research, the real-time retrieval of the host's database of learning resource is supported for the learner to obtain learning materials to make learning in real-time.

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